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# Rural service centers in China: development, spatial distribution, and urban sustainability

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With the rise of rural revitalization, rural service centers, specialized in governing and serving rural areas and characterized by certain cultural attributes, have emerged in rural planning. This article aims to analyze and evaluate the spatial distribution of these rural service centers across different regions, including their distribution patterns and the specific layout and zoning of micro-spatial functions. A combination of field surveys, data collection, and Geographic Information System analysis is employed to investigate the spatial characteristics of rural service centers in China. The study found that: (1) the number of rural service center construction projects across Chinese provinces has increased since 2017, peaking in 2021; and (2) the regional distribution varies significantly. Eastern and southeastern provinces such as Jiangsu, Zhejiang, and Guangdong exhibit a high concentration of rural service centers, attributed to strong economic development, compact urban construction bureaus, and high land-use efficiency. In contrast, the western and northeastern provinces—including Gansu, Heilongjiang, and Jilin—show a lower concentration, due to factors such as challenging natural environments, climate conditions, and slower economic development. This spatial distribution clearly reflects regional disparities in economic development, population density, and levels of urban and rural infrastructure.

## KEYWORDS

rural service centers, spatial distribution, urban sustainability, spatial form, building type, cultural preservation

## 1 Introduction

### 1.1 Research background

In the context of urbanization and rural revitalization, the development of rural service centers is of vital importance (Rao et al., 2023; Yin et al., 2022). Rural settlements in China consist of communities predominantly engaged in agriculture, facing challenges such as economic underdevelopment, aging populations, and inadequate infrastructure

(Han, 2020; Yuan et al., 2018). Rural service centers are a key element of this strategy, providing essential services and promoting cultural and social cohesion (Tao et al., 2022). The 19th National Congress of the Communist Party of China aims to achieve comprehensive rural development through the *Five Major Revitalizations* report (Liu, 2024; Liu, 2020). On 16 October 2022, in the report of the 20th National Congress of the Communist Party of China, it was stated to “comprehensively promote rural revitalization” and emphasized the need to “build livable and prosperous rural areas that are both pleasant to live in and conducive to business” (Yu, 2022). The *Rural Revitalization Strategy Plan (2018–2022)* released by Chinese mainland also mentioned a number of sustainable development goals, including promoting the sustainable development of agriculture and rural areas and increasing government investment in key areas and weak links such as green agricultural production, sustainable development, rural living environments, and basic public services (Ministry of Agriculture and Rural Affairs of the People's Republic of China, 2018). As the urban-rural gap problem becomes more prominent, rural areas are facing the dilemma of lagging economic, social, and infrastructure development (Yu et al., 2023; Gao and Liu, 2020; Zhang and Zhang, 2020). Changes in the rural population structure, such as aging and labor outflow, have further exacerbated the complexity of rural development (Ao et al., 2020; Zeng et al., 2021; Liu et al., 2020). In this context, rural service centers, such as public service buildings, play a crucial role in rural development, and their significance has garnered growing attention. It is not only a platform for providing rural information consultation and rural services, but also an important platform and place for public services to display regional culture, organize villagers to participate in rural governance, establish a villager deliberation system and democratic decision-making mechanism, improve villagers' participation awareness and autonomy, rural grassroots governance, and assist government departments in carrying out administrative management and public service work. It provides strong support for fostering rural economic growth, advancing social equity, and reducing the gap between urban and rural areas. Further in-depth exploration of its distribution and influencing factors can better guide the rational layout and sustainable development of rural service centers and promote coordinated progress between urban and rural areas.

The construction of rural service centers is an important link in promoting the integrated development of urban and rural areas and achieving the strategic goal of rural revitalization. Against the background of the increasingly prominent problem of unbalanced urban and rural development, rural service centers bear the historical mission of bridging the urban-rural gap. By integrating the natural, social, and cultural resources of rural areas, these service centers not only provide rural residents with basic services such as education, medical care, and employment guidance but also become an important hub for rural social innovation and economic development (Yang et al., 2024). For example, in the fields of rural tourism and cultural creativity, service centers have created possibilities for the linkage between rural specialty products and urban markets by building display and trading platforms, thereby effectively enhancing the competitiveness and sustainable development capabilities of the rural economy. In addition, rural service centers reconstruct the organizational structure of

rural society and enhance its governance capacity by creating opportunities for community participation. This participation not only enhances the sense of belonging and pride of rural residents in the community but also lays the foundation for grassroots democratic construction (Rao et al., 2023). By building an efficient grassroots service network, rural service centers have achieved the effective allocation of urban and rural resources and social capital and promoted the transformation of rural areas from “weak links” to “development engines”. This model not only improves the quality of life of rural residents but also makes rural areas an important part of the country's modernization drive, laying a solid foundation for achieving the grand goal of common prosperity.

In addition to their economic functions, rural service centers also play a vital role in enhancing rural social cohesion and inheriting local culture. By offering public activity spaces and cultural communication platforms, these centers serve as a conduit for fostering emotional connections among residents and enhancing the intimacy of rural community relations. For example, by holding rural cultural festivals, traditional craft exhibitions, and other activities, service centers help villagers regain their sense of identity with local culture while also opening a window for the outside world to understand rural culture (Liu et al., 2021). This cultural interaction not only enriches rural social life but also promotes cultural exchanges between urban and rural areas, thus laying the foundation for building an inclusive and harmonious society. Driven by modernization, the demographic structure and social composition of rural areas are undergoing profound changes. Many regions face the dual challenges of aging and the outflow of young labor, and rural service centers have alleviated the social problems brought about by these changes by providing targeted services, such as elderly care programs and youth skills training courses (Yin et al., 2022). More importantly, these centers have enhanced residents' awareness of participating in public affairs and promoted the modernization of rural governance by organizing community councils and democratic decision-making activities.

## 1.2 Problem statement and objectives

The core objective of this study is to explore in depth the spatial distribution characteristics of rural service centers and their distribution patterns in different regions. This exploration not only focuses on the geographical layout of service centers at the macro level, that is, how they are distributed in different rural areas, but also aims to reveal the underlying reasons and influencing factors behind these distributions. Through detailed data collection and analysis, we will be able to depict the distribution density of rural service centers and understand their distribution in different geographical regions, economic levels, and social backgrounds. This analysis helps us better understand the geographical distribution patterns of rural service centers and provides scientific basis for future planning and construction.

This Article will focus on the specific layout and zoning of micro spatial functions of rural service centers, as well as their construction characteristics. We will examine in detail the basic information of the construction year, area, and number of floors of the service center to reveal their construction and development trends in different historical stages and regional backgrounds. At



the same time, we will also conduct in-depth analysis of multiple key dimensions of rural service centers, including analyzing the correlation between the building area of service centers and their construction years, as well as exploring the relationship between the number of floors of rural service centers in different provinces and their geographical distribution or development characteristics. In addition, through policy guidance and resource allocation, the government gives priority to promoting the construction of service centers in specific regions. For instance, in economically developed and densely populated eastern provinces such as Jiangsu and Zhejiang, the government encourages the centralized construction of service centers in these areas through special fund support and land preferential policies, in order to optimize resource allocation, meet the service demands of high-density populations, and enhance service efficiency. Therefore, this study will focus on examining the selection of construction areas for rural service centers in various provinces, as well as the potential connections between these construction areas and construction years, with the aim of revealing the strategies and trends of different provinces in the construction of service centers. Through these detailed analyses, we aim to understand the spatial layout and development model of rural service centers, and further summarize and generalize the main forms of rural service center building floor plans and the functional diversity they carry. This provides strong data support and theoretical basis for the planning, design, and functional optimization of future rural service centers.

## 2 Literature review

Rural service centers play a crucial role in the sustainable development of urban and rural areas by providing essential services such as healthcare, education, and governance (Mihai and Iatu, 2020). These centers help bridge the gap between urban and rural areas by enhancing access to public services, improving the quality of life for rural residents, and supporting local economic development (Mansor et al., 2013). They serve as hubs for community engagement, cultural preservation, and the delivery of social welfare programs, which are key components of rural revitalization efforts (Zhang et al., 2024). Looking at international examples, countries such as Japan, South Korea, and several European nations have implemented effective models for rural public service facilities. For instance, Japan's Machi-zukuri (community building) approach integrates rural service centers into broader regional development plans, ensuring that these centers not only provide services but also support local culture and identity (Satoh, 2020). Similarly, South Korea's smart village initiatives use advanced technology to enhance rural public services, focusing on sustainability and efficiency (Park and Lee, 2019). In Europe, particularly in countries like Germany and France, rural service centers have been linked to decentralized governance, providing flexible and adaptive services to rural populations, thus promoting social equity and environmental sustainability (Tent et al., 2021).

In these research, some scholars have noted that cultural elements are considered the essence of rural revitalization and the foundation of rural social stability. A positive rural cultural atmosphere makes the vitality of rural settlements' development more lasting. For example, creating a positive cultural atmosphere

requires cultural construction, including cultural service centers, cultural investment and expenditure, and rich festival activities. The cultural service center is a place for villagers to carry out cultural exchange activities. The "cultural service center" they mentioned is also a place concept in the countryside that is like the rural service center (Rao et al., 2023). Song and Li (2020) examined the evolution of spatial patterns of rural settlements in Tongzhou District, China, demonstrating how the spatial distribution of these settlements has changed over several decades due to socio-economic factors, urbanization, and regional planning efforts. Their study also underscores the importance of understanding spatial dynamics in rural areas to effectively plan for future development and manage the impacts of urbanization. Tao et al. (2022) examined the spatial distribution characteristics and influencing mechanisms of rural settlements in mountainous areas, providing valuable insights into how environmental and socio-economic factors shape rural development. The distribution of rural populations is not only shaped by economic and social factors but also by climate change, which exacerbates vulnerabilities in already disadvantaged regions. Recent studies have utilized GIS and remote sensing techniques to predict the dissipation of rural settlements due to climate change, providing valuable insights into how climatic factors such as extreme rainfall, wind, drought, and temperature affect rural areas (Valjarević, 2024). Zhu et al. (2010) utilized GIS tools to evaluate and optimize the spatial distribution of rural settlements, providing a comprehensive framework for improving rural settlement planning and addressing spatial challenges. Barbier and Hochard (2018) analyzed the relationship between rural population distribution and climate change, highlighting how environmental changes exacerbate poverty and influence the spatial distribution of rural communities. In a similar context, Igić et al. (2020) explored the impact of climate change on rural settlements in Southern and Eastern Serbia, highlighting how changing climatic conditions significantly affect rural development and the built environment.

In the study of urban and rural development, the allocation of public service facilities has always been a core issue. In order to ensure that public service facilities can meet the needs of different regions, the theory of public service facility allocation has put forward a framework for optimized allocation, aiming to ensure that the distribution of facilities can be reasonably arranged according to the regional needs and development goals. Especially in rural areas, rural service centers, as basic public service facilities, can significantly improve the service accessibility of residents and promote the fair distribution of social resources. According to the research of Zhu et al. (2018), the theory of public service facility allocation guides the process of spatial planning of rural facilities, ensuring that the location and functions of facilities are consistent with the population's needs and regional development goals. In China, particularly in the less economically developed western regions, the rational layout of rural service centers can effectively bridge the gap in public services between urban and rural areas. Under the guidance of this theory, it is possible to better analyze and optimize the functional distribution of rural service centers, to achieve more efficient and fair resource allocation. Therefore, the theory of public service facility allocation provides theoretical support for this study, helping to analyze from the perspective of planning how to promote the balanced development of urban and

rural public services through the rational allocation of rural service centers. It also provides a theoretical basis for policymakers to support their planning decisions in different regions.

China's growing demand for rural governance and public services is the foundation for the origin and development of rural service centers. With the deepening of urban-rural integration and the rural revitalization strategy, rural service centers have gradually become important facilities for improving rural public services and enhancing social governance capabilities. National policies such as "new rural construction" and "rural revitalization strategy" have strongly supported their development (Li et al., 2020). Studies have shown that rural service centers are comprehensive and multifunctional, covering multiple fields such as healthcare, cultural education, and agricultural technology promotion, and they have played an important role in promoting the flow and sharing of urban and rural resources (Svendsen and Lind, 2009). In recent years, the construction of digital and intelligent rural service centers has become a research hotspot. Related studies have explored the possibility of improving rural governance efficiency and service quality through intelligent technology (Feng and Li, 2020). At the same time, scholars also pointed out that the construction of rural service centers is of enormous significance for optimizing rural space utilization and promoting the coordinated development of production and living functions (Svendsen and Lind, 2009). For example, Qian et al. (2009) analyzed the integration of the health service system with rural service centers as the core and proposed an application path in medical and health reform. Furthermore, Yang, (2014) views rural service centers as the central hub for innovative rural social governance, contributing significantly to grassroots governance and resource integration. These studies show that rural service centers are not only an important practical carrier of the rural revitalization strategy but also a key node for promoting urban-rural integration and social governance innovation.

Cultural elements play a key role in rural revitalization. Studies have shown that cultural elements are not only the cornerstone of maintaining rural social stability but also the core factor in promoting local sustainable development. A positive cultural atmosphere helps to enhance the social identity and sense of belonging of local residents, thereby enhancing the cohesion of the community and promoting local social and economic development (Nan, 2021). For example, as a representative of cultural facilities, cultural service centers not only provide a place for cultural exchanges for villagers but also provide support for social interaction and the reconstruction of community spirit. Nan (2021) pointed out that these cultural service centers are particularly important in areas with rich historical backgrounds. They not only enhance villagers' sense of identity with local culture but also promote the inheritance of cultural heritage. Further research (Li et al., 2024) shows that the construction of cultural service facilities is a key part of the rural revitalization strategy, which can help local areas improve overall social capital through cultural exchanges and education, thereby driving the comprehensive development of the community. Furthermore, cultural construction in rural revitalization encompasses the integration of cultural education and community activities. Zhu et al. (2024) explored how rural cultural services can promote the sustainable development of ecosystems and communities through experiential learning. As a base for cultural education, the Cultural Service Center can effectively enhance

residents' awareness of environmental protection and protection of local culture, laying a solid foundation for the sustainable development of rural areas.

Cultural centers play a vital role in rural revitalization, as they not only promote community participation and protect cultural heritage but also improve the quality of life for residents. Despite the importance of cultural centers in rural development, their construction process faces many challenges, including resource shortages, insufficient local participation, and sustainability issues. One of the most prominent challenges in the construction of cultural centers is funding. Rural areas are often economically backward and lack sufficient funds to develop and maintain cultural infrastructure. Although government grants and projects may provide financial support for initial construction, these projects often face budget cuts or poor fund management, which may lead to construction delays or unsatisfactory results (Yu et al., 2024). In addition, the long-term maintenance of these cultural centers is also a continuous financial burden for local governments or community organizations, as rural areas often lack sufficient economic foundation to sustain these projects (Hampton, 2005). For example, Quayson (2024) pointed out that financial constraints are the main obstacle to combining cultural heritage with rural economic development, and insufficient funds may weaken the impact of such projects on local communities. In addition, the governance structures in rural areas are often insufficient to effectively manage the complex processes involved in building cultural centers. Coordination between local governments, cultural organizations, and communities is often weak, which can lead to delays, inefficiencies, or conflicts in projects. Yang et al. (2024) pointed out that governance fragmentation in rural development projects, with overlapping responsibilities and poor communication among multiple departments, hinders effective planning and implementation. In addition, rural governance systems often lack the expertise required to manage cultural projects (Van and Hornidge, 2023). These problems are not only financial challenges but also administrative challenges, as many local governments lack the ability to implement policies and cannot effectively integrate cultural development into broader rural revitalization strategies. Local communities' needs and aspirations should guide the design and construction of cultural centers. However, ensuring active community involvement in the planning and construction process is often a challenge. Rural residents are often skeptical of new government-led projects, especially when they perceive them as externally imposed rather than co-developed (Yu et al., 2024). Community resistance may stem from a lack of understanding of the potential benefits of cultural centers or from past experience of similar projects failing to deliver on their promises. In addition, outmigration of young people may lead to an aging population in rural areas, and the cultural needs and priorities of these older residents may differ from those of the project's target groups (Yang et al., 2024). These issues highlight the importance of ensuring that cultural centers are culturally relevant and community-driven when designing them.

In general, existing scholars focus on the construction of rural service centers as governance platforms and cultural centers in rural areas. With the development of the rural economy, more and more rural service centers need to be built. The summary of space design and construction in existing sample cases is still insufficient and needs further exploration. Based on these previous

studies, the innovation of this study lies in the integration of GIS technology with functional deconstruction. Through a multi-dimensional analysis of the functions of rural service centers, a new theoretical perspective is proposed. This perspective not only considers the spatial distribution of rural service centers but also combines the actual needs of each functional module. It explores more refined and efficient layout schemes for service centers, thus promoting the further development of the planning of public service facilities.

### 3 Methods and materials

This study employs a combination of field surveys, data collection, and Geographic Information System (GIS) analysis to investigate the spatial distribution and characteristics of rural service centers in China. The research scope is rural service centers, and the name is limited to rural service center buildings. Complete information must be provided, including the province where it is located, the region, the number of floors, the construction year, and the functional area floor plan, *etc.* The relevant engineering information was verified by searching on the official websites of the planning departments of provincial and municipal governments ([www.gooood.cn](http://www.gooood.cn)) and by searching on Baidu ([www.baidu.com](http://www.baidu.com)). It includes three main parts: field survey, data collection, and annotation analysis. Firstly, the research team gathered and selected rural service center buildings that aligned with the research objectives from the design studio's completed projects. Then, the research team used field surveys and website searches to verify the information of the rural service center buildings, including their province, area, number of floors, year of construction, and functional areas. This information was cross verified through online searches and official records. It should be noted that GIS analysis relies on the accuracy and completeness of data, and in areas with insufficient network coverage or opaque information. This study aims to enhance the accuracy and credibility of the research through manual correction of cross-validation. Next, we transformed their specific addresses into coordinate systems and entered them into the GIS platform for display. Finally, we obtained the GIS analysis results (Figure 1). The collected data were then mapped using GIS to visually represent the distribution patterns and analyze the density of rural service centers across the country.

On a macro scale, in the western provinces of China, due to complex terrain and harsh climate, service centers are sparsely distributed. Over-reliance on the financial input and construction scale of economic policies to guide the development of its functional zones. Relying on policy support and self-updating, the functions of the service centers in the eastern provinces and regions have become more complete. At the micro level analysis, we annotated the functional areas and architectural floor plans of each rural service center for easy visualization analysis. The researchers manually annotated and distinguished the floor plan and functional zoning of the building using the following colors: (1) land use outline: blue-green (R0, G255, B189); (2) land use range: black (R0, G0, B0); (3) exhibition: yellow (R240, G255, B0); (4) community center: red (R255, G42, B0); (5) elevator shaft or stairwell: dark blue (R0, G12, B255); (6) kitchen: rose purple (R255, G0, B186); (7) Meeting room: dark orange (R255, G108, B0); (8) Courtyard rest area or landscape

area: violet (R114, G0, B255); (9) Corridor: sky blue (R0, G198, B255); and (10) toilet: green (R0, G255, B72).

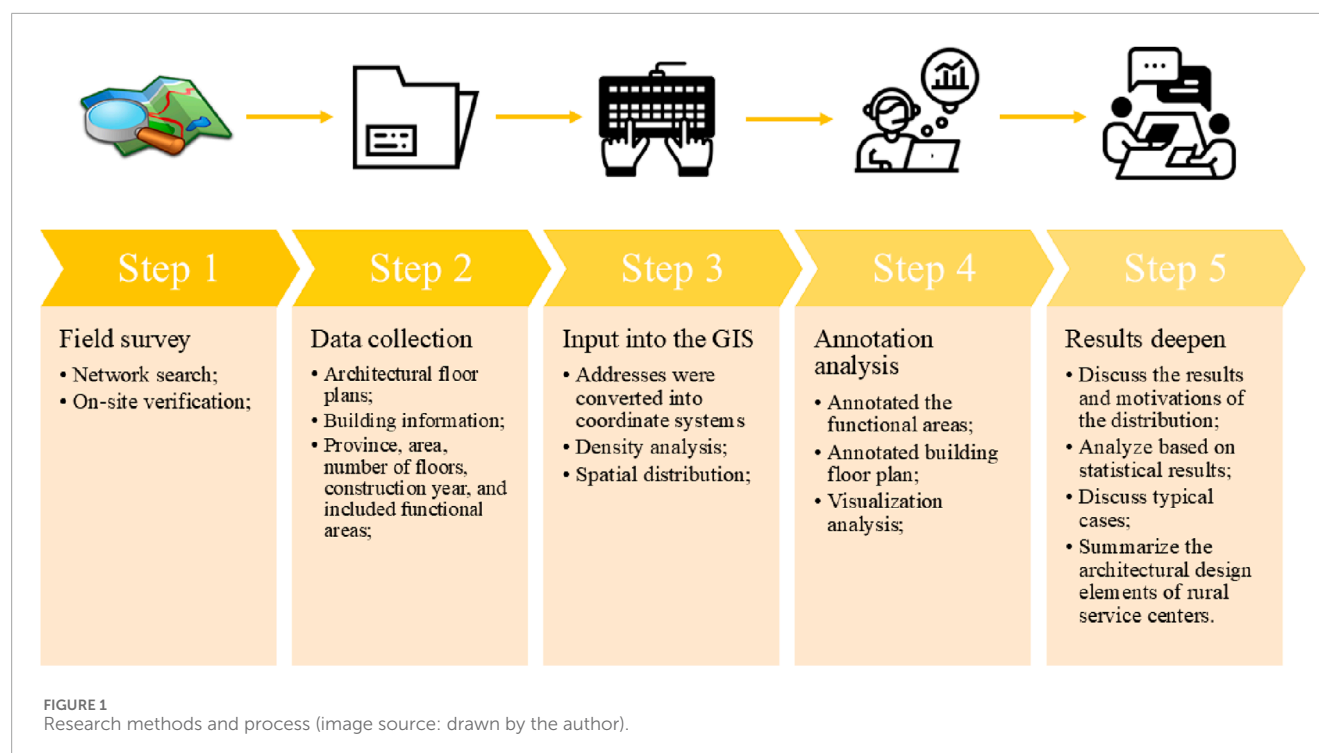
The significance of this study lies in its examination of the spatial patterns of rural service centers, which are critical to the ongoing rural revitalization efforts in China. Understanding these distribution patterns is essential for optimizing future infrastructure development and promoting balanced urban-rural integration. Additionally, the study highlights the role of these service centers in facilitating rural governance, economic development, and cultural preservation, addressing gaps in existing literature regarding their design and regional differences. By offering a thorough analysis of the factors influencing the construction and layout of these centers, this research provides valuable insights that can inform policy and planning decisions for rural development in the future.

## 4 Results

### 4.1 Regional spatial distribution and characteristics

#### 4.1.1 Distribution density of rural service centers

Figures 2, 3 reveal significant differences in the distribution of rural service centers across various provinces in China, highlighting clear gaps in economic development, population density, and urban and rural construction levels in different regions. Jiangsu Province holds the top ranking with 39, significantly outperforming other provinces and underscoring its significance in this indicator. Jiangsu Province's highly developed economy, dense population, and high degree of urbanization may contribute to this high distribution, demonstrating its advantages in resource allocation and the construction of urban and rural infrastructure. However, it is also worth noting that Jiangsu has actively implemented policies to promote rural revitalization, with targeted allocation of special funds to support the construction of rural service centers, which has further accelerated the development in this regard. The *Rural Revitalization Strategy (2018–2022)* emphasizes resource allocation to underdeveloped areas, particularly rural regions in the western part of the country, including special funding for infrastructure construction. This policy support has significantly promoted the development of rural service centers, especially in the western regions where funding is relatively scarce. These policies have guided the flow of funds and resources, accelerating the construction of rural service centers. Followed by Zhejiang Province, the number is 21, which also shows a higher distribution. Zhejiang Province has experienced rapid economic development and increasing urbanization levels in recent years, the provincial government's strategic planning and policy support for rural construction, such as preferential land use policies for rural service facilities, have jointly promoted the concentrated distribution of this indicator in Zhejiang. These factors have jointly promoted the concentrated distribution of this indicator in Zhejiang. Furthermore, the prominence of provinces like Sichuan, Guangdong, and Henan, with their respective numbers of 14, 13, and 11, underscores the significant role these regions play in economic development and population. These provinces have a wide geographical location and cover different economic regions. Sichuan and Guangdong have high economic influence nationwide, and Henan is a province with a



large population, which provides a sufficient basis for this indicator. Moreover, Sichuan, with its complex terrain including basins and mountains, has adapted its rural service center construction to local topographical features, optimizing the number and layout of buildings. Guangdong, benefiting from preferential policies for rural development in the special economic zones, has enhanced the construction of rural service centers. Shaanxi and Chongqing, with their respective numbers of 6 and 5, exhibit a relatively stable level of development, likely due to their moderate economic development and population concentration. In contrast, the number of provinces such as Beijing, Yunnan, and Hebei is 3, while the number of provinces such as Hunan, Shandong, and Jiangxi are 2, and the number of Liaoning and Gansu is only 1, showing a lower distribution. Numerous factors, including the level of economic development, population density, and geographical environment, may constrain the low distribution in these areas. Especially in the northwest regions, such as Gansu, the natural conditions are relatively harsh; the climate and terrain are not suitable for large-scale urban and rural construction; and the economic development is somewhat lagging, resulting in less distribution of this indicator in these areas. The harsh natural conditions, with arid climate and rugged terrain, pose challenges to large-scale urban-rural construction. The difficult terrain restricts the building height and scale, increasing construction costs and thus resulting in fewer rural service centers. Additionally, the relatively insufficient policy support compared to developed regions also constrains the development in these areas. The economically developed regions in the east and southeast, such as Jiangsu, Zhejiang, and Guangdong, tend to have a higher distribution on this indicator, while the west and northeast show a lower distribution due to the influence of natural conditions, population distribution, and economic level. This distribution characteristic clearly reflects

the imbalance in urban and rural development and economic resource distribution in different regions of China.

In Figures 2, 3, based on provincial regional standardization, the calculation method of GIS is adopted by province as the unit. At the economic level, eastern provinces such as Jiangsu and Zhejiang have developed economies and abundant fiscal resources, which enables them to invest more in rural infrastructure. In contrast, western provinces like Gansu, Qinghai and Xinjiang have relatively lagging economies, which restricts the construction of service centers. In terms of policy support, government-level policy support is particularly significant. For instance, Zhejiang has vigorously developed projects such as future rural construction, which have had a more remarkable actual promoting effect on the eastern regions. In terms of geographical conditions, the complex terrain and harsh climate in the west significantly increase the construction cost and limit the number of service centers, while the relatively superior natural environment in the east is conducive to the construction and operation of service centers.

Figure 4 below displays the resulting building density distribution after inputting the existing rural service center distribution points into GIS. Parts of Jiangsu Province, Zhejiang Province, and Sichuan Province (such as the Pearl River Delta) mainly concentrate the most obvious high-density areas (red). These areas are darker in color, with a building density of 0.001132–0.000391 per square kilometer. This may be because Jiangsu Province, and Zhejiang Province are economically developed provinces with high urbanization levels and dense populations. The construction party of rural service centers is a government agency, which has a profound impact on the layout of service centers. The *Rural Revitalization Strategy Plan (2018–2022)* emphasizes promoting sustainable development in agriculture and rural areas, increasing government investment, directly driving the

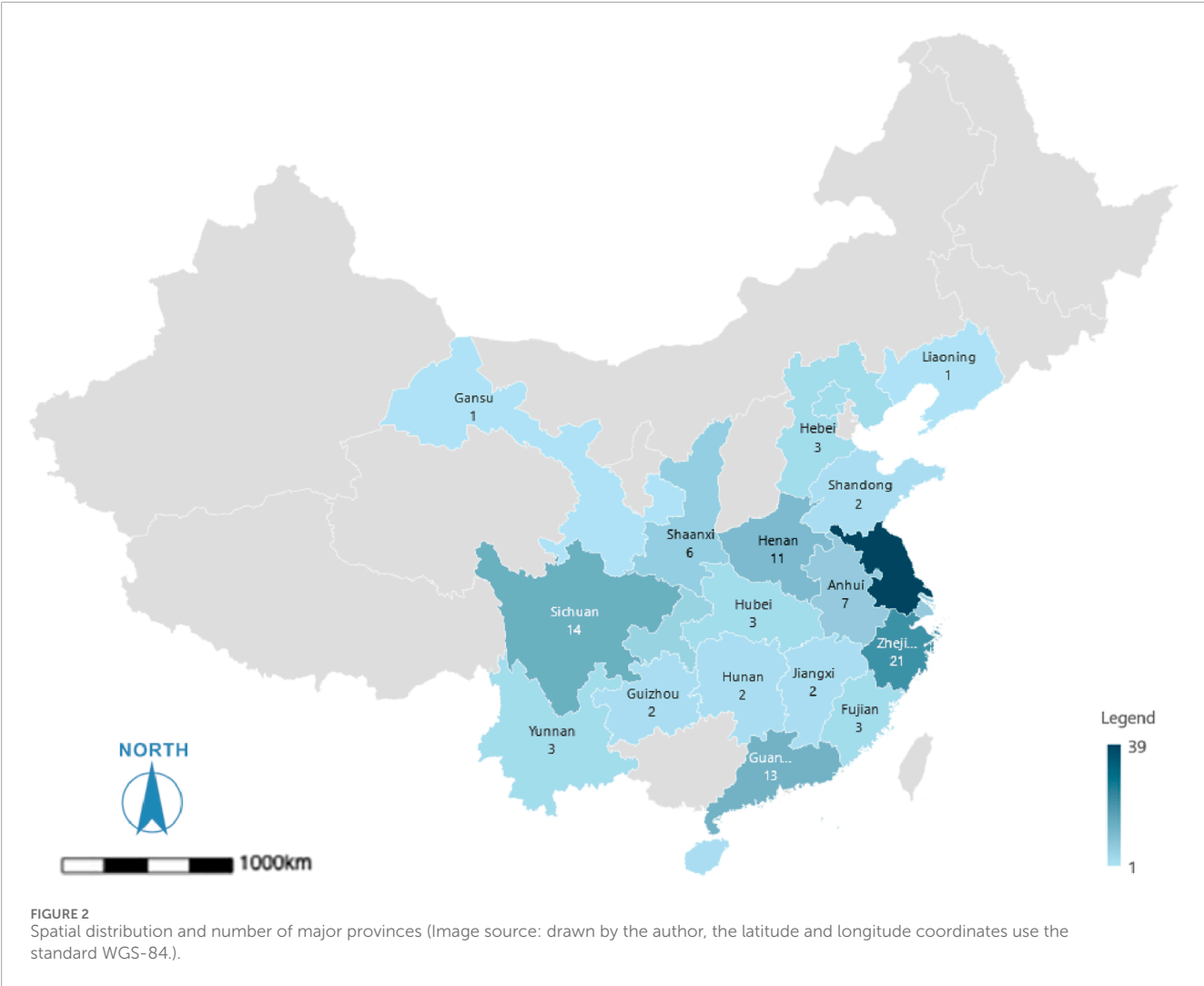


FIGURE 2  
Spatial distribution and number of major provinces (Image source: drawn by the author, the latitude and longitude coordinates use the standard WGS-84.).

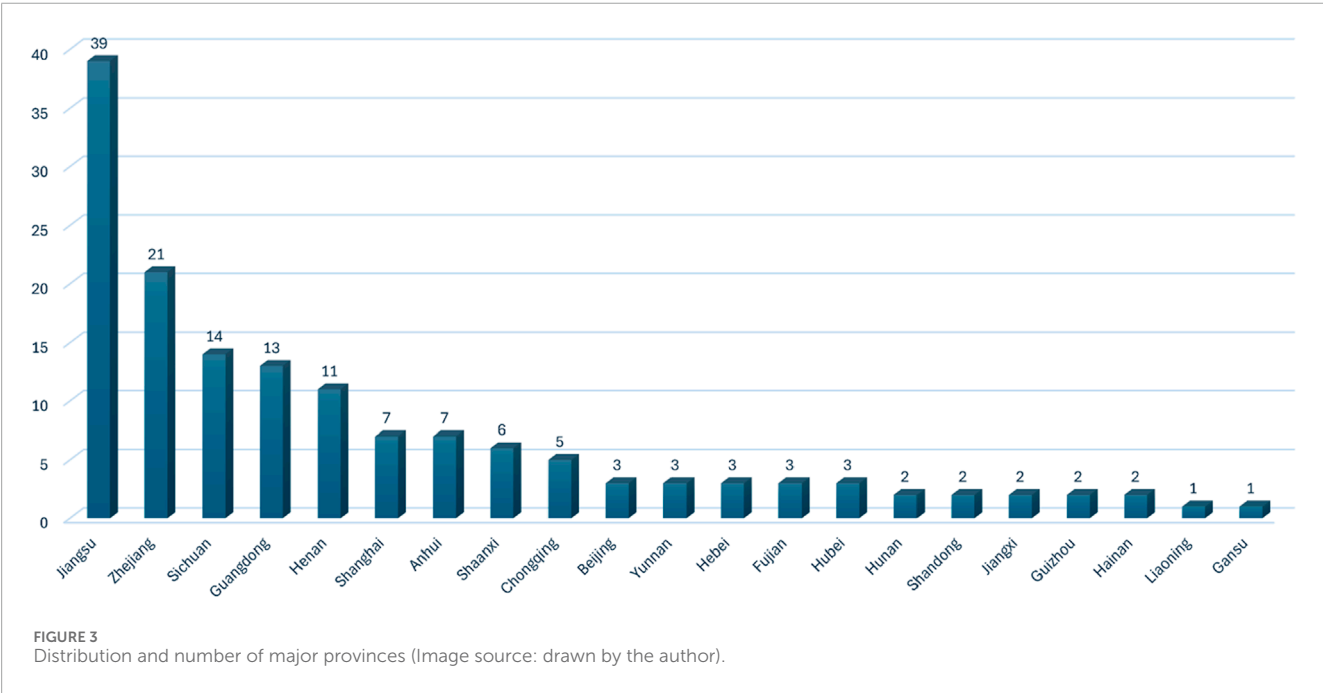


FIGURE 3  
Distribution and number of major provinces (Image source: drawn by the author).



construction of rural service centers, and reaching a construction peak in 2021. Jiangsu Province and Zhejiang Province attract abundant resources due to their economic development, compact urban construction, and high land use efficiency. The construction of rural service centers has great advantages. Additionally, they vigorously promote the rural revitalization policy, which has led to the emergence of numerous rural service centers and a high-density distribution. Secondly, the areas with higher density (orange) are mainly distributed in Beijing, Tianjin, Shaanxi Province, Henan Province, Anhui Province, Chongqing, and most cities in Guangdong Province in China. Especially along the provinces of Sichuan, Jiangsu, and Zhejiang, where the density is the highest, the ring is distributed in an extended manner, with a building density of 0.000045–0.000132 per square kilometer. The lowest density is currently mainly distributed in Heilongjiang, Jilin, most of Inner Mongolia, Gansu, Qinghai, Xinjiang, Tibet, and most of Ningxia (green). Despite Heilongjiang and Jilin's vastness, they are characterized by a cold climate, a relatively sparse population, and a dispersed distribution. Additionally, the natural environment places certain restrictions on urban construction. Grasslands and deserts dominate most of Inner Mongolia. Large-scale construction is not feasible in the natural environment, leading to a concentration of population in a few towns. Gansu, Qinghai, and Xinjiang are located in the northwest, with harsh natural environments such as drought, high cold, and deserts. The population is sparse and unevenly distributed, with economic development lagging behind. These factors together lead to extremely low building density in rural service centers. It is worth noting that this distribution overlaps with the Hu Huanyong Line (Heihe-Tengchong Line); that is, the building density is relatively high on the southeast side of the Hu Huanyong Line and relatively low on the northwest side. The Hu Huanyong Line is an important dividing line for China's population distribution, with a dense population on the southeast side and a sparse population on the northwest side. The population distribution also significantly influences the building density of rural service centers. Densely populated areas often have a higher demand for buildings and public facilities, which may lead to a higher building density. In addition, there are significant differences in the level of economic development on both sides of the Hu Huanyong Line. The southeast side boasts a developed economy, whereas the northwest side remains relatively backward. In other words, areas with better economic development tend to have more industrial activities and population agglomeration, which in turn promotes urban and rural construction and building development, ultimately increasing building density.

#### 4.1.2 Construction year, construction area and number of floors

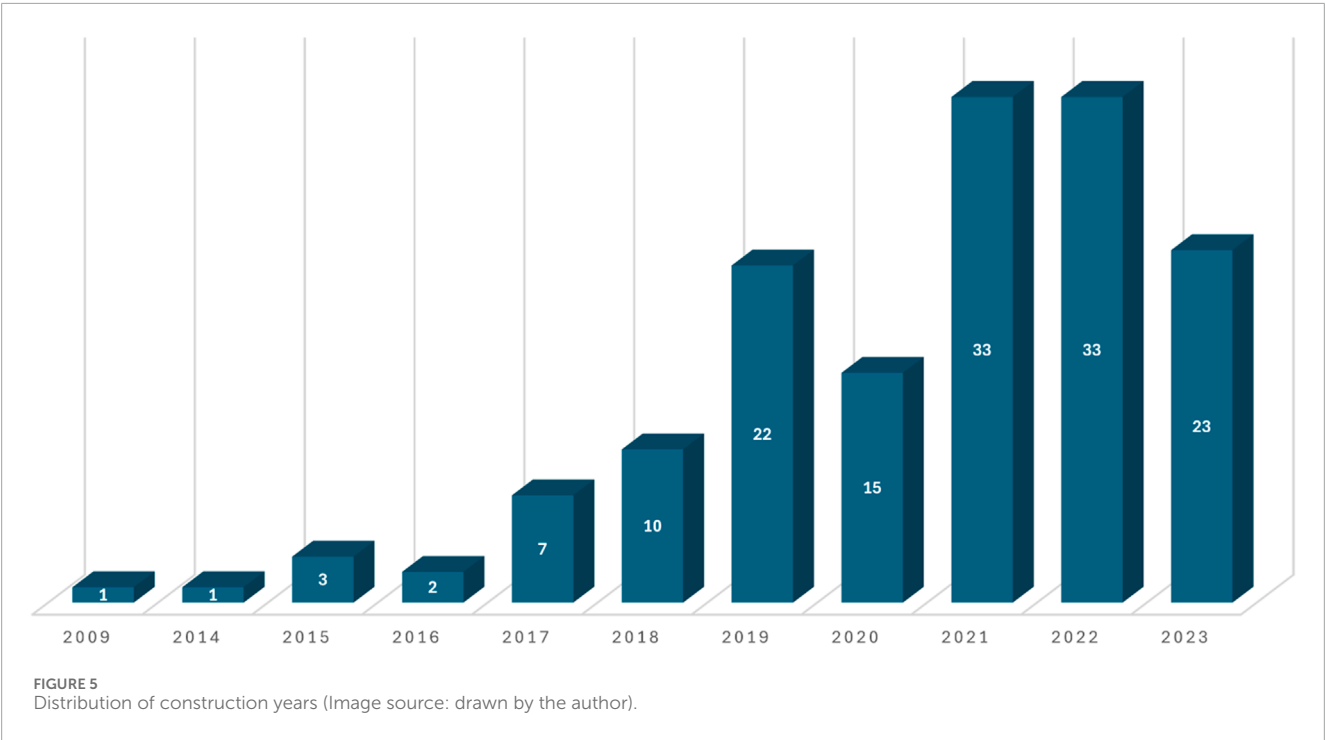
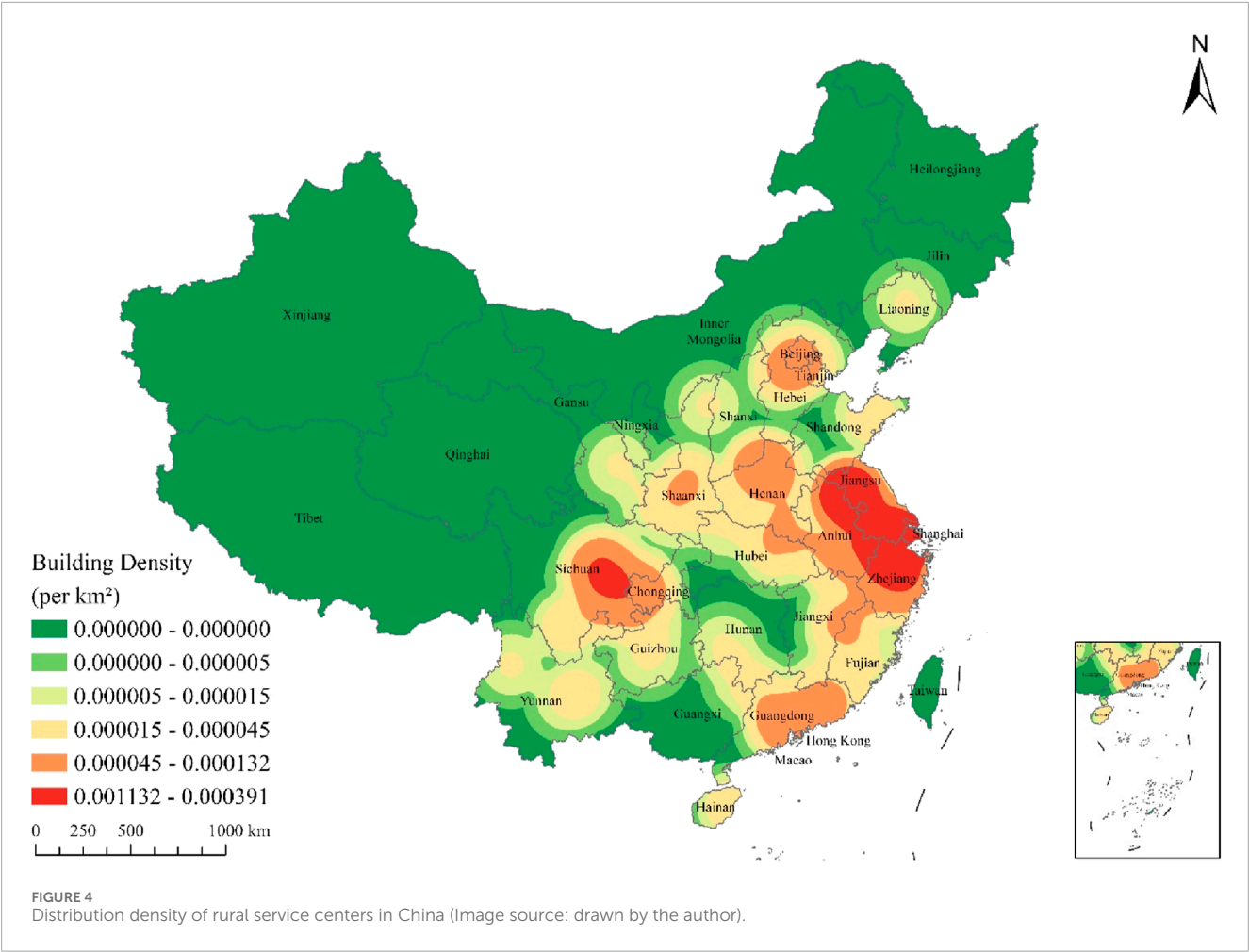
Figure 5's distribution of building numbers by year reveals a cycle of slow, rapid, and decline in construction activities between 2009 and 2023. This figure not only reveals the fluctuation of the number of buildings in different years but also reflects the impact of multiple factors, such as economic development, policy support, and the urbanization process, on construction activities.

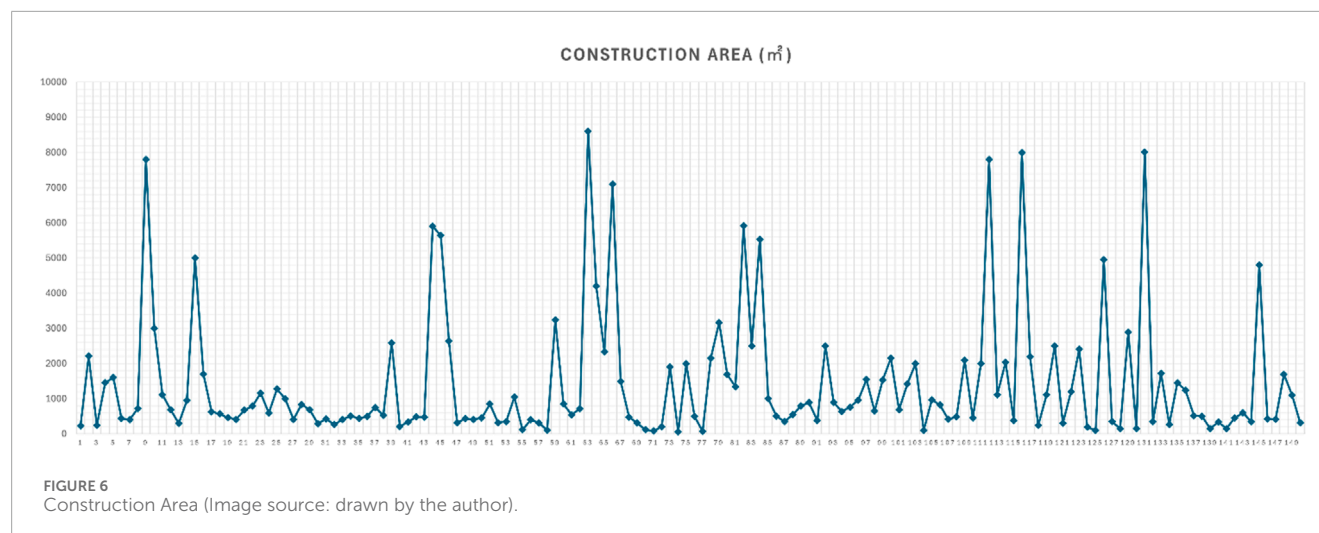
- (1) Early stage (2009–2016): From 2009 to 2016, the number of buildings in this stage grew slowly and with little fluctuation. One building per year from 2009 to 2014, with little

growth. There was a slight increase in 2015, reaching three buildings, but it fell back to only two buildings in 2016. The relatively stable economic growth rate and the still-initiating urbanization process may have contributed to the relatively stable construction activities during this period. Furthermore, the low number of early-stage buildings could potentially indicate the insufficient efforts of local governments to encourage construction or the necessity for significant updates to urban infrastructure.

- (2) Accelerated growth period (2017–2019): Starting in 2017, the number of construction projects began to increase significantly, indicating that construction activities entered a period of acceleration. The number of buildings increased to seven in 2017, 10 in 2018, and 22 in 2019. Many factors, including the country's increased infrastructure investment and the implementation of new urbanization policies, may have contributed to the rapid growth in the number of buildings during this period. Simultaneously, the acceleration of economic development has led to a rapid increase in demand for construction facilities in various locations, particularly for public facilities, commercial buildings, and residential buildings. This has resulted in a rapid growth trend in construction activities.
- (3) Peak construction period (2020–2022): Although there was a slight decline in 2020, with the number of buildings reaching 15, construction activity rebounded rapidly after this year. In both 2021 and 2022, the number of buildings will reach 33, marking the peak period for the number of buildings. The emergence of this peak period could be attributed to national policies that are more inclined to support infrastructure construction, improve the urban-rural gap, and promote local economic development during this period. Simultaneously, during these years, local governments may intensify their efforts to promote construction activities by providing special funds and increasing public projects, with the aim of enhancing local infrastructure and raising living standards. Demand for urbanization may also drive the peak in building numbers. As the population gathers in cities, the demand for residences, commercial facilities, and public services increases significantly, thus promoting the rapid growth of the number of buildings.
- (4) Fall in 2023: By 2023, the number of buildings has fallen back to 23, slightly lower than the peak levels in 2021 and 2022. A variety of factors, such as market saturation, slowing economic growth, or the impact of policy controls, may affect this decline. However, even with the decline, the number of 23 buildings is still significantly higher than pre-2019 levels, indicating that demand for construction activity remains high. It could also mean that while the construction boom is easing a bit, demand for new construction remains, perhaps focusing more on maintaining existing buildings, making functional updates, or improving building quality.

Figure 6 illustrates the significant differences in the building areas of rural service centers. Some of the building areas exceed 9,000 square meters, forming several significant peaks, while the majority of the building areas are smaller, concentrated around 1,000 square meters. Below square meters. The peaks of these areas may





correspond to large-scale rural service centers with more complete functions, providing a variety of public service functions, such as medical care, education, cultural activities, *etc.*, thus requiring larger building space. A smaller building may be a service center with a relatively single function, containing only basic service facilities. This difference in the distribution of building areas reflects the diversity in the design and functional orientation of rural service centers. While some rural service centers serve as regional hubs, necessitating larger spaces to accommodate multi-functional requirements, others function as small service centers, catering to the basic needs of villages or communities. Overall, Figure 6 illustrates the uneven distribution of construction areas for rural service centers. This diverse area distribution aligns with the varying scales and service needs prevalent in rural areas.

Figure 7 shows the distribution of floors in rural service center buildings, reflecting the significant differences in the number of floors among these service centers. Data shows that most rural service centers are low-rise buildings, especially 2-story buildings, which are the most common, with a total of 83 buildings, clearly occupying a dominant position. However, outliers exist, such as the average of three floors in Liaoning, which deviate from the overall pattern. Several factors may contribute to this phenomenon. Economically, Liaoning, as an old industrial base, possesses a certain level of industrial foundation and financial resources, enabling relatively more investment in the construction of rural service centers, which might allow for taller buildings. Policy-wise, local government initiatives aimed at enhancing rural public service capabilities could encourage the construction of multi-story service centers to integrate diverse functions. Geographically, the relatively flat terrain in many areas of Liaoning reduces the construction difficulty and cost associated with increasing building height, facilitating the construction of three-story buildings. These unique economic, policy, and geographical conditions jointly result in the deviation from the common floor distribution pattern observed in other regions. This feature could potentially align with the functional requirements of the rural service center. The 2-story structure offers ample space for basic public service facilities like conference rooms, activity spaces, and information desks, catering to the service needs of rural communities. Next in line are the

1-story buildings, comprising a total of 39 structures. Small rural service centers or public facilities with a single function can use this type of building, making it suitable for use scenarios that do not require multi-story structures. The number of 3-story buildings is 18, which is relatively small. They are usually suitable for service centers with more comprehensive functions and can accommodate more facilities, such as multi-functional halls, libraries, *etc.* There are only 7 4-story buildings, while there are only one and 2 5-story and 6-story buildings respectively. This shows that high-rise structures are relatively rare in rural service centers. This may be because the demand for building height in rural areas is not high or is limited by construction costs, functional requirements, and other factors. Overall, the number of floors of rural service center buildings is concentrated in one–three floors, with two floors being the main ones, which meets the needs of rural areas for complete functions, moderate space, and easy construction.

## 4.2 Mutual analysis

### 4.2.1 Relationship between construction area and year

Figure 8 shows the fluctuation of the construction area of rural service centers over the years, from which we can observe significant peaks and troughs in construction activities, reflecting that the construction of rural service centers does not grow linearly but is cyclical and affected by multiple factors fluctuation.

- (1) Peak period characteristics: 2018 is the most significant peak period, with a construction area of nearly 9,000 square meters, far exceeding other years. This phenomenon suggests a significant concentration of resources and funds on the construction of rural service centers during 2018. Strong policy support, particularly through policies like the rural revitalization strategy and rural infrastructure improvement, typically drives such peaks, increasing the likelihood of intensive implementation of large-scale rural service projects. The pace of project advancement by local governments or relevant departments may also correlate with

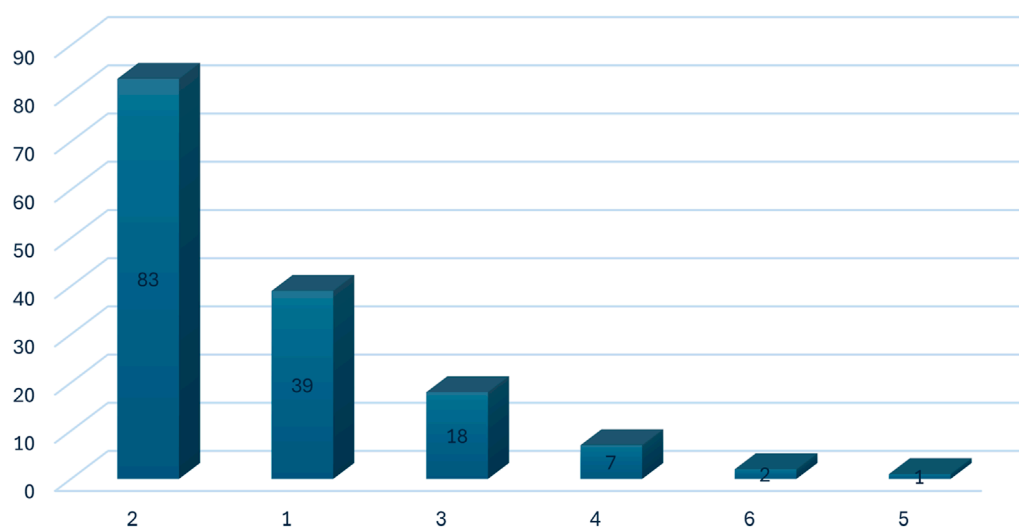


FIGURE 7  
Number of floors (Image source: drawn by the author).

the high construction area in 2018. For example, some areas concentrated on building a number of large-scale service centers with comprehensive functions during this period to quickly improve the level of public services in rural areas.

- (2) Sub-peak phenomenon: 2020 is another relatively significant peak. Although the construction area has not reached the height of 2018, it is still significantly higher than in other years. This may indicate that the construction of rural service centers has received phased support in 2020, possibly to further promote the improvement of rural infrastructure. The impact of the global epidemic in 2020 may have necessitated the strengthening of rural health and medical infrastructure, leading to another minor surge in the construction of rural service centers.
- (3) Distribution of troughs: Troughs occurred in several years, especially in 2015, 2016, and 2022, when the construction area was close to zero. Multiple factors, including insufficient funds and resources, delays in the approval process, cyclical restrictions on project planning, or reduced policy support, may limit these troughs. The occurrence of troughs could suggest a lack of priority for the construction of rural service centers, a shift in resource allocation towards other areas, or a slowdown in the pace of construction due to external factors. Additionally, some trough years may serve as the “accumulation period” for peak years, during which projects are accumulated, funds are raised, and design and planning are conducted in the years prior to the peak to achieve concentrated construction during the peak.

## 4.2.2 Relationship between province and floor number

Figure 9 illustrates the average number of floors in rural service centers across each province, highlighting the distinct choices made in the construction of these centers. Overall, the average number of floors in rural service centers primarily falls

within the range of 1.0–2.5 floors, with notable variations across different provinces. This distribution not only reflects the way local governments respond to rural service needs but may also involve multiple influencing factors such as geographical environment, land resources, population density, and economic conditions.

- (1) Concentrated distribution of high-rise buildings: The number of floors of rural service centers in provinces such as Liaoning, Guangdong, and Zhejiang is relatively high, with an average of 2.5–three floors. The average value of nearly three floors in Liaoning Province suggests that its rural service centers may favor multi-story building designs, potentially due to the local government’s focus on land use efficiency. In areas such as Liaoning with a large population and relatively scarce land resources, multi-story buildings can provide more service functions on limited land, such as community activity rooms, libraries, training rooms, *etc.*, to meet the diverse public service needs of rural residents. The economic level of these provinces and the high demand for rural services may also contribute to this phenomenon. As an economically developed eastern coastal province, Zhejiang’s rural service centers not only provide basic services but also undertake the functions of promoting rural culture, education, and grassroots governance. Therefore, the construction of multi-story buildings can increase service facilities within a limited space and meet residents’ needs for comprehensive services such as education, medical care, and cultural activities.
- (2) Characteristics of provinces with a moderate number of floors: The average number of floors in Shanghai, Chongqing, Hubei, and Hunan is about 2, indicating that these provinces have adopted a moderate number of floors in the construction of rural service centers. This design can not only meet higher service needs but also avoid the cost burden and maintenance pressure brought by high-rise buildings. Even though Chongqing is not as economically advanced as the eastern coastal provinces, their rural service centers continue

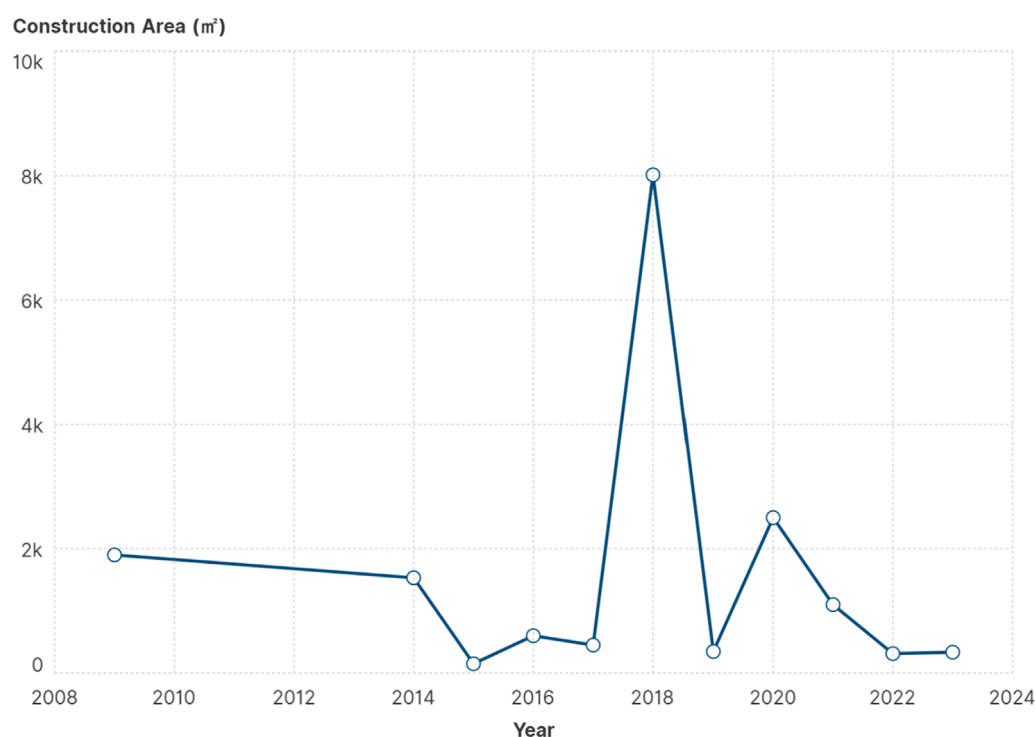


FIGURE 8  
Relationship between construction area and year (Image source: drawn by the author).

to serve the countryside and drive the development of suburbs. The rural service centers in these provinces may contain some relatively complete functional facilities but will not pursue high-rise buildings too much but will selectively provide service functions that meet the needs. This moderate number of floors also reflects the cost control of rural infrastructure and the reasonable allocation of service functions.

- (3) The prevalence and reasons for low-rise buildings: In Hainan, Guizhou, and other locations, the average floor count is relatively low, hovering around 1.5 floors, particularly in Guizhou, where the average floor count approaches 1.0, and the majority of these buildings are single-story structures. This distribution reflects the low demand for rural service centers in these areas, which may be due to geographical restrictions, low economic development levels, and the relatively simple needs of residents. Guizhou is located in a mountainous area with complex terrain, which makes it difficult to build high-rise buildings and relatively costly. For some economically underdeveloped areas, single-story or 1.5-story service centers are sufficient to meet the basic needs of local residents, such as providing medical care, simple cultural activities, and administrative services. As an island province, Hainan's service center construction is affected by land conditions and climate factors such as typhoons, and it may also prefer low-rise buildings to reduce risks and facilitate maintenance.
- (4) Geographical and climatic conditions can also influence the number of floors in rural service centers across various provinces. For example, in Hebei and Liaoning in North China, the winter is cold, and the heating and maintenance costs of building high-rise buildings are high, so the number of floors will not be too many, while in Hainan and Fujian in the south, typhoons are frequent, and low-rise buildings are safer and more resistant to risks in the face of natural disasters. In addition, mountainous provinces such as Guizhou and Yunnan have complex terrain and are not suitable for multi-story buildings, resulting in rural service centers being mainly low-rise buildings.
- (5) Reflection of economic development level: Provinces with a higher average number of floors, such as Zhejiang, Guangdong, and Liaoning, often have certain advantages in economic development and can invest more funds in rural infrastructure construction. Rural service centers in these areas not only meet basic service needs but also undertake rural cultural promotion, social governance, education, training, *etc.*, which require larger space and functional distinction, which has led to the emergence of multi-story buildings. In contrast, in less developed provinces like Guizhou, Jiangxi, and Gansu, the average number of floors in service centers is lower, and the building design primarily focuses on meeting basic needs. In these provinces, the control of construction costs and limited resources may be the key factors in determining the number of floors of rural service centers.
- (6) Influence of local policies and planning: The policy inclinations of different provinces in rural revitalization and infrastructure construction may also have an impact on the number of floors of rural service centers. Some provinces with faster economic development and stronger policy support are more inclined to provide diversified public service facilities in rural areas,



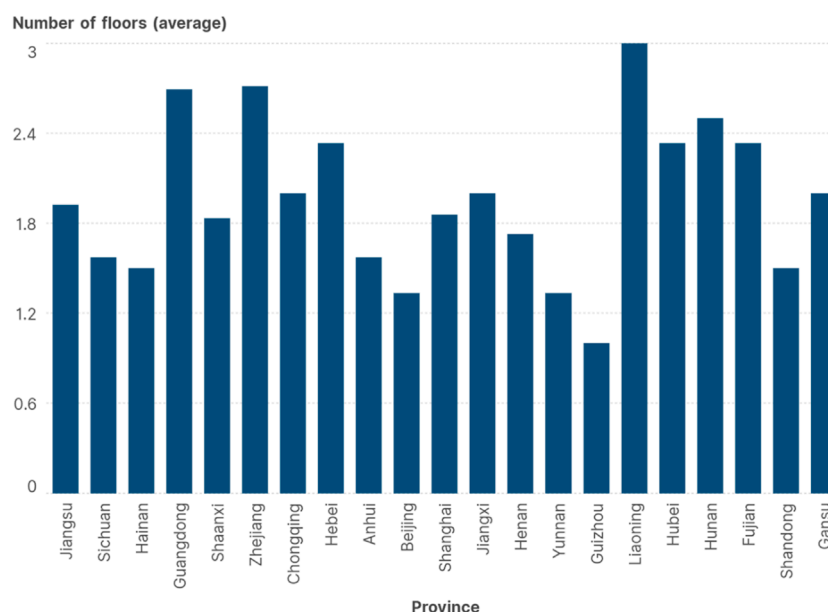


FIGURE 9  
Relationship between the number of floors of provincial and rural service centers (Image source: drawn by the author).

which usually require larger spaces and more complex building structures. Therefore, these provinces tend to have a higher number of floors in their rural service centers. In provinces with relatively less policy support or limited fiscal budgets, building low-rise service centers mainly for basic services is a more practical choice.

#### 4.2.3 Relationship between province and construction area

Figure 10 illustrates the distinction between urban and rural development in the construction of rural service centers. Economic development typically occurs in the eastern coastal areas of provinces with large construction areas, whereas the construction areas of rural service centers in the central and western regions tend to be smaller. This difference reveals the resource allocation and priority issues faced by different provinces in promoting the rural revitalization strategy. If economic conditions permit, developed provinces in the east can provide more resources to support the construction of rural public service facilities, while relatively underdeveloped regions may only prioritize meeting basic needs.

The province with the largest area is Jiangsu. Jiangsu's construction area surpasses 35,000 m<sup>2</sup>, demonstrating the province's significant investment in the development of rural service centers. This high area may reflect Jiangsu's developed economy and greater demand for rural services, which requires the construction of more and larger rural service centers to provide comprehensive public services, such as medical care, education, and cultural activities. Jiangsu's significant investment may also indicate the province's proactive attitude in narrowing the gap between urban and rural areas and promoting rural revitalization.

- (2) Provinces with larger construction areas: Guangdong and Zhejiang also have significant construction areas, both

exceeding 28,000 m<sup>2</sup>. Guangdong and Zhejiang are both economically developed eastern coastal provinces, exhibiting strong economic strength and diverse demands for service centers in rural areas. The larger area of the rural service center may be to adapt to the characteristics of higher rural population density and diverse service needs and to provide a variety of service functions, including culture, medical care, entertainment, *etc.* In addition, economically developed regions have sufficient financial resources to support large-scale construction investment. Henan's construction area is also relatively large, close to 20,000 m<sup>2</sup>. This high construction area indicates that Henan, as a populous province, also has a strong demand for rural service centers. Henan's rural service centers may undertake a variety of public service functions to meet the diverse needs of the rural population.

- (3) Provinces with medium construction areas: Shaanxi and Chongqing also have construction areas of more than 10,000 m<sup>2</sup>, showing the importance these regions attach to the construction of rural service centers. Although Shaanxi and Chongqing have relatively medium economic levels, they may have invested more in the construction of rural service centers due to the high concentration of rural population or the urgent need for rural development. The construction areas of Beijing, Shanghai, Anhui, Liaoning, Hunan, Fujian, and other provinces are between 5,000 and 8,000 m<sup>2</sup>, showing that these provinces have invested a certain amount in the construction of rural service centers but have not reached the high investment level of the eastern coastal areas and provinces with large populations. This medium construction area may be due to the consideration of reasonable allocation of resources, ensuring that rural residents receive basic services while controlling construction costs. The construction of rural service centers in

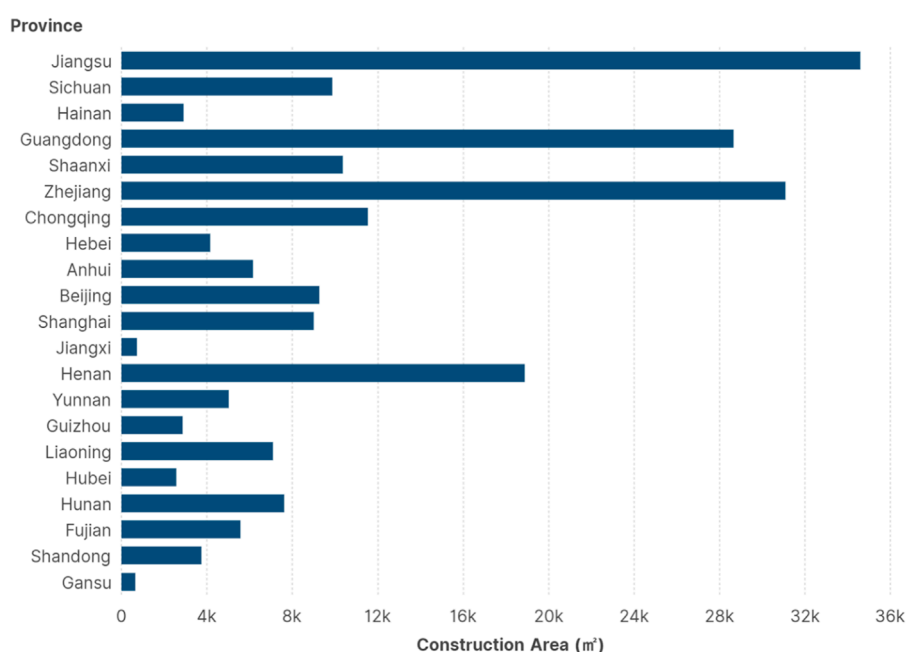


FIGURE 10  
Relationship between province and construction area (Image source: drawn by the author).

these provinces may primarily serve to meet basic cultural and medical needs.

- (4) Provinces with smaller construction areas: Hainan, Jiangxi, Guizhou, Shandong, and Gansu have smaller construction areas, all below 4,000 square meters, especially Jiangxi and Gansu, where the area is below 1,000 m<sup>2</sup>. The local economic development level, geographical environment, and rural population size may influence this smaller construction area. Relatively backward economic regions may prioritize meeting basic needs, leading to the construction of rural service centers that are primarily low-cost and have smaller construction areas to accommodate limited budgets. In addition, some regions with complex geographical environments, such as Guizhou, have a more dispersed rural population distribution and may choose small-scale, multi-point distributed service centers to cover a wider range, so the area of a single service center is smaller.
- (5) The impact of economic and policy factors: Economically developed provinces like Jiangsu, Guangdong, and Zhejiang have made more investments, potentially benefiting from their abundant financial resources and policy support. In these regions, rural service centers not only undertake basic services but may also have added educational, cultural, and social governance functions. Therefore, the construction area in these provinces is larger, reflecting the impact of economic conditions on the investment in rural public service facilities. For economically underdeveloped regions or those with a small rural population, such as Gansu, Jiangxi, and Hainan, the construction area of rural service centers is relatively small. This may be due to the limited local financial resources; the construction goal is mainly to meet the most basic

service needs, and the service center area is correspondingly smaller.

- (6) Reflection of urban-rural development differences: Economic development typically occurs in provinces with large construction areas in the eastern coastal areas, while the construction areas of rural service centers in the central and western regions tend to be smaller. This difference reveals the resource allocation and priority issues faced by different provinces in promoting the rural revitalization strategy. If economic conditions permit, developed provinces in the east can provide more resources to support the construction of rural public service facilities, while relatively underdeveloped regions may only prioritize meeting basic needs.

#### 4.2.4 Relationship between province and construction year

Figure 11 reveals the distribution characteristics of rural service center construction in terms of time and province. Specifically, it can include (1) concentration period of construction activities: It can be clearly seen from the figure that the construction activities of rural service centers are mainly concentrated after 2016, especially between 2020 and 2022, with significant new construction projects. increase. The distribution of a large number of construction sites during these years suggests that policies or concentrated resource investment may have driven this period. The implementation of the national rural revitalization policy may have contributed to this phenomenon. With the support of the policy, many provinces have increased the construction of rural infrastructure.

- (2) Construction starts and early development: Before 2016, there were relatively few rural service center construction projects,

with only a few provinces and a few years of sporadic construction sites. For example, Jiangsu started building rural service centers around 2010 and Henan around 2015, but the number was relatively small. Such early construction activities may be pilot projects or rural public service facility construction carried out in advance by individual provinces and have not yet formed a nationwide centralized construction trend.

- (3) Regional distribution differences: Figure 11 shows that provinces such as Jiangsu, Zhejiang, Guangdong, Shaanxi, and Henan have had construction activities in multiple years, indicating that these provinces have continued to invest in and are highly active in the construction of rural service centers. These regions may have strong economic strength or large populations and high demand for rural public services, so they have continued to build service centers in multiple years to meet the needs of different regions. In contrast, provinces such as Hainan, Jiangxi, and Gansu have relatively few construction sites, and their distribution is discontinuous. This may reflect that these provinces have relatively low investment in the construction of rural service centers or that construction activities are mainly completed in a few years and have not been expanded on a large scale since then.
- (4) Concentrated provinces with construction peaks: During the construction peak from 2020 to 2022, provinces such as Zhejiang, Guangdong, Sichuan, and Henan were particularly active, with a large number of new rural service centers added each year. The high frequency of increased construction of rural service centers in these provinces may suggest a pressing need for rural revitalization, and the government is actively promoting infrastructure improvements to enhance living and service conditions in these areas.
- (5) Possible policy drivers: The concentrated construction period of rural service centers is highly consistent with the rural revitalization policy and rural infrastructure construction policy promoted by the country in recent years. After 2016, as the government gradually increased its support for public service facilities in rural areas, many places began to build rural service centers on a large scale to provide basic medical, educational, cultural, and other services. Especially from 2020 to 2022, the impact of the COVID-19 pandemic may have accelerated the construction of public service facilities in rural areas to improve the quality of life and public health conditions of rural residents.

## 4.3 Building plan form and function

### 4.3.1 Building plan form

Further statistics found that the building layout of rural service centers is mainly divided into two categories: rectangular and special-shaped (Figure 12). The primary characteristics of these two types of building plan forms are as follows: (1) The relatively regular spatial layout of the rectangular building plan greatly aids in the division of conventional functional spaces within the rural service center. For instance, one can easily partition the rectangular space in functional areas like offices and conference rooms, thereby

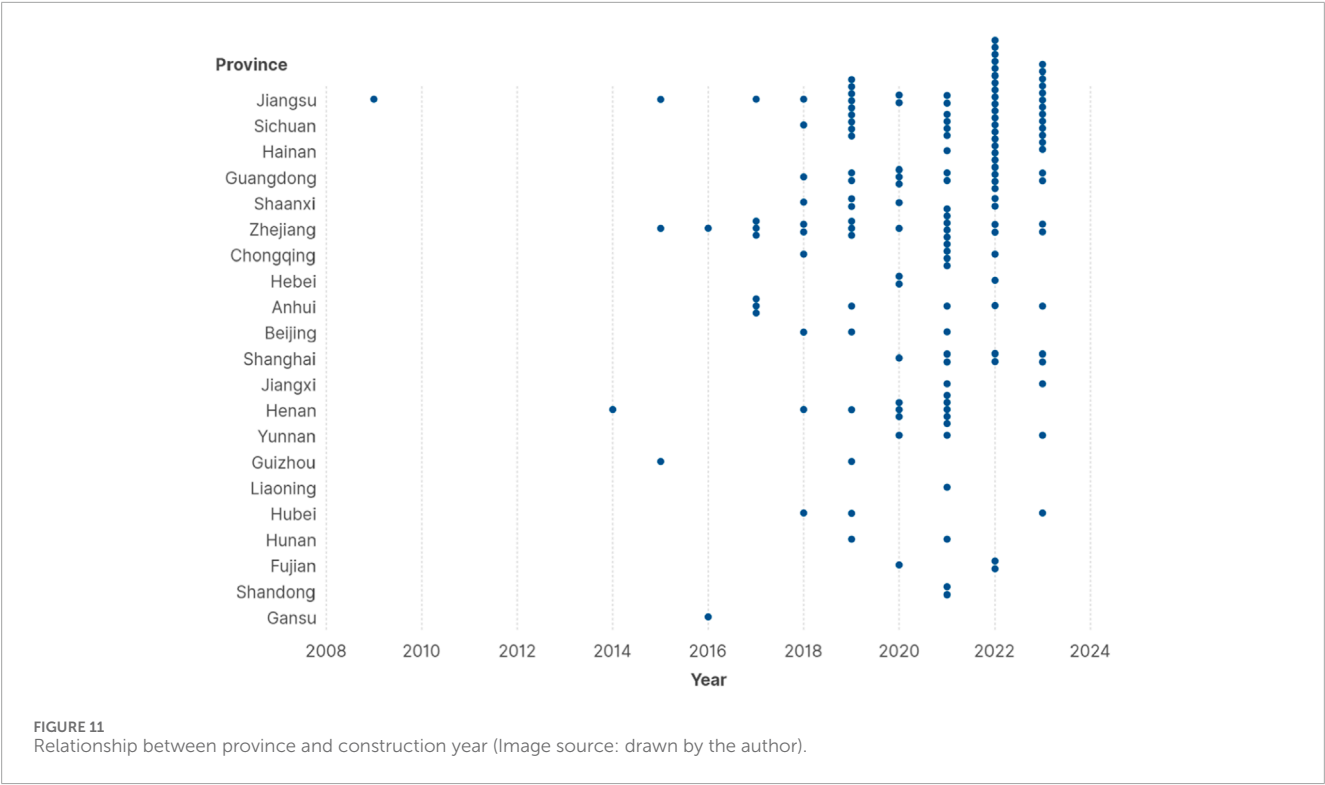
optimizing space utilization and minimizing waste. For example, in the office area of a rural service center, the rectangular room can easily place office furniture such as desks and filing cabinets and can be arranged according to a certain module, making the office space neat and orderly. Its traffic flow is also relatively simple to organize. The corridor can be arranged in a straight line to connect the various functional rooms. When walking inside the building, people maintain a clear sense of direction and are unlikely to become lost. For example, in a rural service center that mainly provides government services, villagers who come to do business can quickly find different service windows along the straight corridor. In addition, rural service centers with rectangular architectural forms are mostly located on one side of the central square of the village. They can be parallel to the boundary of the square, making the building more coordinated with the surrounding environment.

- (2) The special-shaped plan primarily serves to meet specific functional requirements, most of which are fulfilled through the renovation and design of the original old buildings in the village. For instance, a display area in a rural service center may require a circular or irregular space to establish a distinctive display atmosphere. For example, in the exhibition hall of some rural specialty agricultural products, the use of special-shaped planes can create a creative display space to attract visitors' attention.

### 4.3.2 Building function

Figure 13 shows the main functional zoning layout of the rural service centers counted in this study. This includes eight main functional areas: exhibition, community center, elevator shaft or stairwell, kitchen, meeting room, courtyard rest area or landscape area, corridor, and toilet.

- (1) Exhibition area: it mainly displays village history. This is also one of the characteristic functional areas of the rural service center. Collection and exhibition are the basic functions of the village history museum. Through the display of archival materials such as village history, deeds of people, family trees, agricultural production and living supplies, local products, honors of villagers and villages, development achievements, and future plans, the true face of history can be reproduced, so that villagers can know the past of the village and clarify the future development direction of the village. At the same time, archival exhibits engraved with the imprint of the times can promote emotional identification and resonance among villagers, giving them a greater sense of belonging. Additionally, the construction of the village history museum offers a viable means of preserving and passing on local culture. It materializes the villagers' memories by displaying village records, personal deeds, family trees, *etc.*, reveals the hidden rural memories, prevents them from disappearing over time, and realizes "retaining nostalgia" and "seeking cultural roots". Every village, regardless of its history, has a unique historical and cultural heritage. In particular, the village history museum, built on the basis of historical buildings, as an important carrier of cultural inheritance, has become a part of rural history and culture and has found a way for "cultural



accumulation”. On one hand, the village history museum boasts a strong historical and cultural atmosphere, along with a wealth of knowledge and interest. This atmosphere has a subtle influence on the growth and development of young people, making it an important social classroom. On the other hand, the village history museum helps purify rural customs and promote the construction of rural spiritual civilization.

Several village history museums have received recognition as foundations for patriotism education. In addition, by holding cultural activities such as festival folk customs and classic recitations, the village history museum enriches the cultural life of the villagers. As a rural public cultural facility, the village history museum is not only an ideal place for residents to entertain and relax, but also, with the development of

digital technology, the application of multimedia and virtual reality has further enhanced its entertainment, making it a comprehensive place integrating education and entertainment. In terms of rural governance, the village history museum serves as a platform for promoting outstanding moral models and role models, cultivating a cultural atmosphere of respect for the elderly and love for the young, valuing literature and virtuous individuals, and serving as a forum for publicizing village affairs, discussing issues, and mediating disputes, thereby effectively fostering rural harmony. Therefore, the exhibition area with village history as the main content is often also the most important functional area of the rural service center.

- (2) Community center: It is mainly an important place for handling rural government affairs. For instance, the community center offers a variety of government service windows, including those for managing household registration, processing social security, handling civil affairs (such as applications for minimum living allowance and disability certificates), and handling land transfer procedures. These windows provide villagers with one-stop government services, and villagers no longer need to travel long distances to towns or counties to handle various procedures, saving time and energy. Simultaneously, these windows serve as a crucial platform for the dissemination of rural information. For example, through bulletin boards and electronic display screens, national and local policies and regulations, agricultural subsidy information, village planning schemes, engineering project bidding information, *etc.*, are released to villagers in a timely manner. In addition, community centers provide office space for various rural social organizations (such as rural cooperatives, volunteer associations, and elderly associations). With the support of community centers, these social organizations can better carry out activities and serve rural development. For instance, rural cooperatives can gather members to discuss planting plans and sales strategies for agricultural products, thereby enhancing the organization of agricultural production.
- (3) Elevator shaft or stairwell: Rural service centers with multiple floors typically feature elevator shafts, offering villagers a convenient vertical transportation method. For example, a rural service center has three floors, with the first floor being the service hall, the second floor being the meeting room and office, and the third floor being the exhibition room. Whenever villagers come to attend training, they need to take the stairs or elevator to reach the third floor. Elevators are essential facilities that enable the elderly, disabled individuals with limited mobility, and those carrying heavy objects to reach their destination with ease. In addition to personnel, the transportation of materials also needs to be considered. The transportation of items such as office equipment, activity props, books, and materials between floors depends on vertical transportation. If the rural service center regularly updates the equipment in the conference room, such as large projectors and sound systems, this equipment can be transported to the corresponding floors by elevator to ensure that materials can be efficiently circulated within the building. The location of stairs and elevators plays a role in

guiding and connecting the layout of building space. Stairs are crucial safe evacuation routes in emergency situations (such as fire, earthquake, and other disasters). This point-shaped functional area mainly plays the role of traffic and fire evacuation.

- (4) Kitchen: In Chinese mainland, rural service centers often have some of the functions of village committees and have a certain number of village committee staff working in them. Therefore, the kitchen is mainly a work and dining space.
- (5) Meeting room: It is an important place for rural government affairs. Various government work meetings can be held here, such as village committee meetings and CPC member meetings. These meetings play a key role in conveying national policies and guidelines, deploying rural development plans, and discussing public affairs decisions. For instance, upon the issuance of a new agricultural subsidy policy, village committee members convene in the meeting room to meticulously interpret its content and deliberate on its effective implementation in the village, ensuring the policy's benefits reach every villager. Simultaneously, the meeting room serves as a venue for various forms of skill training. For example, agricultural technology training is held according to the actual needs of villagers, such as new crop planting technology and breeding technology training, or non-agricultural skills training is carried out, such as e-commerce operation training and handicraft production training. The villagers improve their skills through concentrated lectures, playing teaching videos, and displaying teaching materials in the meeting room. For example, e-commerce experts are invited to explain to villagers in the meeting room how to open and operate online stores and use the Internet platform to sell agricultural products to promote rural economic development.
- (6) Courtyard rest area or landscape area: it mainly takes the form of courtyard or surrounding greening. Renovations from old traditional buildings have led to a more common courtyard form in rural service centers. Renovations from old traditional buildings in rural service centers are responsible for the majority of atrium forms. Often, courtyard-style buildings feature atriums that transform the landscape, with the larger ones serving as rest areas. Rural service centers with rectangular building plans typically feature surrounding greenery as part of their exterior landscaping design.

## 5 Discussion: Influencing factors and sustainable development paths

### 5.1 Eastern coast case: Dalongyao village rural service center, Yancheng City, Jiangsu Province

The total area of Longyao Village Rural Service Center is 1,327 m<sup>2</sup>, covering functions such as rural services, community medical care, and agricultural supermarket. In order to preserve nostalgia and protect the rural texture, the building continues



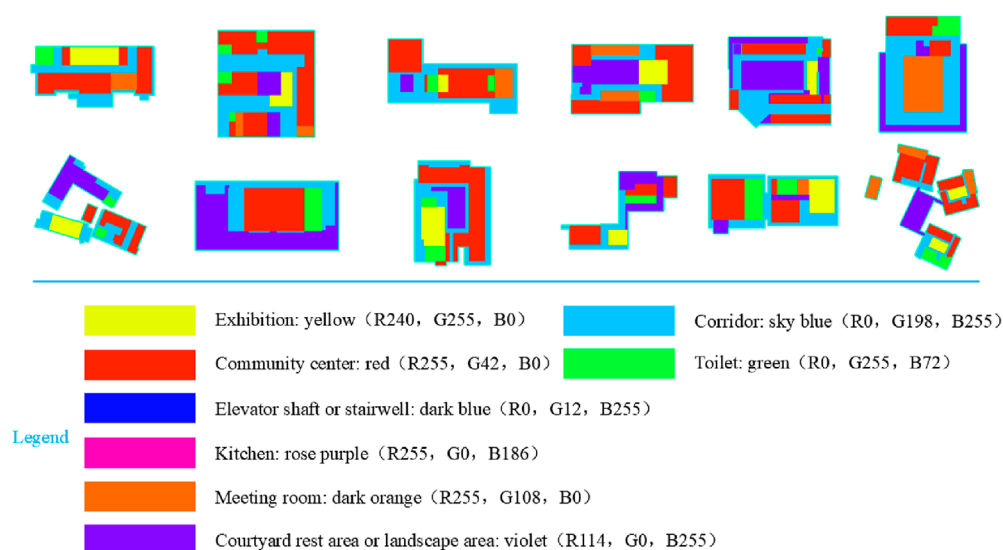


FIGURE 13  
Main functional area layout (Image source: drawn by the author).



FIGURE 14  
Photovoltaic roof design of rural service center in Longyao Village.



FIGURE 15  
Aerial view of rural service center of Shizhuang village.

## 5.2 Central case: Village service center of Shizhuang Village, Huozhou City, Linfen City, Shanxi Province

the red brick elements of the silkworm factory in its design style, and the exterior adopts locally fired red insulation bricks (Feng, Y. 2023). Low carbon building design starts from three aspects: reducing demand, improving energy efficiency, and enhancing production capacity. Comprehensive application of passive technologies such as high-performance enclosure structures and multi-dimensional shading systems, equipped with energy-saving and efficient air conditioning units, heat recovery fresh air and other equipment. This can ensure energy conservation while improving indoor comfort (Figure 14). Integrating photovoltaic and architectural design with sloping roof design. Explore the zero energy building technology path under cost control, and provide leading demonstrations for modern low-carbon rural building design.

Under the compound design, the rural service center of Shizhuang Village is more intensive and efficient. The setting of its composite functions can make the building need less building area under the premise of configuring the same number of functions, and directly save the construction cost. In addition to core functions such as party and government services, convenience services and villagers' activities, the rural service center of Shizhuang Village also undertakes public leisure, cultural and creative experience, retail and other contents in the area (Figure 15). The polysemy construction in the space can make the building have the ability of elastic adaptation. In the case of retaining the main structure of the building, the internal space is renovated to adapt to the different demands of different development stages of the village, thus indirectly saving the construction cost.



FIGURE 16  
Actual picture of Gandong wan village rural service center.

### 5.3 Western case: Rural service center of Gandong Wan village, Yibin City, Sichuan Province

Rural areas in western China are also actively improving the capacity and level of social governance at the rural level, effectively ensuring the in-depth advancement of the rural revitalization strategy. As its economy is less developed, most of the construction projects are reconstruction projects. The service center, which covers an area of more than 600 square meters, is planned to have 10 functional areas such as mediation room, painting room and meeting room, which can provide 20 convenient services such as party members' activities, education and training, and cultural publicity (Figure 16).

### 5.4 Inspiration from the rural service center case for sustainable development

To achieve sustainable development, it is necessary to consider economic, social, environmental and policy factors and take effective measures to solve them. In the case of rural service center in eastern, central and western regions, the relationship between influencing factors and sustainable development is interdependent and mutual, mainly concentrated in the following three aspects.

- (1) Green and low-carbon development. In the more economically developed provinces in central and eastern China, the low-carbon design concept of rural service centers is mainly reflected in reducing carbon emissions, saving energy, and maximizing the use of renewable resources, so as to achieve sustainable development.
- (2) Composite design. In the less developed provinces in central and western China, the space is fully utilized to implant multiple functions. Different functions and Spaces are juxtaposed and overlapped to form a new spatial whole due to a certain connection. Starting with the improvement of rural functions, a multi-functional integrated rural service center will be built that integrates the village committee office, villagers' activities, product display, characteristic workshop, and atrium stage.
- (3) Continue the characteristics of rural architecture. The rural service center is not only a service facility, but

also a display window of rural culture. Therefore, in the design, we should fully explore and display the humanistic characteristics of the countryside, such as traditional architectural features, folk culture, *etc.*, so that the rural service center can become the inheritor and disseminator of rural culture.

## 6 Conclusion

Through GIS technology and quantitative analysis, this paper deeply reveals the spatial distribution characteristics of rural service centers in China, which provides an important scientific basis for optimizing the layout of rural infrastructure and promoting the coordinated development of urban and rural areas. It has extremely high reference value for policymakers and is conducive to promoting the effective implementation of the rural revitalization strategy. This article aims to analyze and evaluate the spatial distribution of rural service centers and the distribution patterns in different regions, as well as the specific layout and zoning of micro-spatial functions. It is important because it provides valuable insights into the spatial distribution of rural service centers in China and their role in addressing challenges such as infrastructure gaps and climate change. Understanding these patterns is crucial for promoting sustainable rural development and improving access to essential services. The study reveals significant regional disparities in the distribution of rural service centers. In this study, the different functional orientations of rural service centers and cultural service centers are clarified. Rural service centers mainly undertake the functions of providing basic public services and social governance, covering aspects such as education, medical care, transportation, and social security. The construction of these centers aims to improve the quality of life of rural residents and promote the balance of public services between urban and rural areas, especially in terms of the coverage of education, medical care, and government services. In contrast, cultural service centers place more emphasis on protecting and inheriting local culture and promoting cultural exchanges and community construction. These centers provide venues for cultural activities, such as libraries, art galleries, and community cultural centers. Their purpose is to enhance community cohesion, boost cultural confidence, and promote cultural prosperity and sustainable development of society. The rural complex design endows the service center with flexible adjustment space. Real-time paths such as courtyards can be used for both leisure and cultural activities, effectively enhancing the efficiency of space utilization. The aim is to strengthen the adaptability of the building and promote community participation and cultural exchange, providing strong support for the sustainable development of the rural service center. Therefore, the design of rural service centers should pay more attention to the comprehensiveness and diversity of functions to meet the basic daily needs of residents, while cultural service centers should focus on strengthening cultural functions and artistic dissemination.

It also introduces a GIS-based method for analyzing spatial distribution, offering new insights into optimizing rural infrastructure and planning for future needs. The study found that the construction projects of rural service centers between

provinces in China have increased since 2017, reaching the peak of construction in 2021. Most of the buildings have two floors. The research also proposed sustainable development paths such as green and low-carbon development and composite design, providing new ideas for the planning and design of future rural service centers. Besides, its regional distribution has the characteristics of significant differences. The eastern and southeastern provinces of Jiangsu, Zhejiang and Guangdong have a high distribution of rural service centers due to their good economic development, compact urban construction bureaus and high land utilization rate. The western and northeastern regions, such as Gansu, Heilongjiang, Jilin and other provinces, due to the natural environment, climate, economic development lag and other reasons, the distribution is low. This distribution clearly reflects the differences in economic development, population density and urban and rural construction levels in different regions.

At present, there are some deficiencies in the research on the spatial distribution of rural service centers. In terms of data acquisition, data statistics in some areas are incomplete, especially in border areas and provinces. Future development in rural areas may lead to the construction of more similar buildings, potentially affecting the accuracy of distribution patterns. In terms of research methods, this study employs a combination of Geographic Information System (GIS) and qualitative statistical analysis. However, rural development is inherently complex, making it challenging to accurately uncover the intricate relationships between various factors. Future research directions include strengthening data collection and integration and using modern technical means to obtain more comprehensive and accurate data, such as machine learning and data analysis technology. At the same time, subsequent research should also deepen theoretical research, build a more complete theoretical model, and comprehensively consider multiple factors and their interactions, as well as focus on dynamic research, consider time factors, and study the changing laws of the spatial distribution of rural service centers over time and future development trends. In future research, although GIS and quantitative tools are good at handling large-scale spatial data and revealing distribution patterns and trends, it is difficult to fully capture the life experiences, emotional experiences of rural residents, and the actual effects of service centers in addressing specific local needs. These qualitative aspects often need to be obtained through in-depth interviews, observations or case studies. Therefore, future research can consider combining quantitative and qualitative methods to better guide the rational layout and sustainable development of rural service centers. Finally, in the future, we should strengthen research on special conditions in different regions, such as ethnic culture and security factors in border areas, to provide a scientific basis for formulating development strategies in accordance with local conditions.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

SY: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing. JS: Formal Analysis, Writing – original draft. YC: Formal Analysis, Funding acquisition, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing. LZ: Data curation, Funding acquisition, Investigation, Project administration, Writing – review and editing. YM: Formal Analysis, Supervision, Writing – review and editing. YH: Conceptualization, Investigation, Writing – review and editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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